

What is claimed is:

1 1. A method for determining configuration parameters describing a physical
2 system, the method comprising the steps of
3 measuring an output signal from the system in response to an input signal,
4 the output signal being related to the configuration parameters by a linear operator, and
5 directly reconstructing each of the configuration parameters by applying a
6 prescribed mathematical algorithm to the output signal.

1 2. The method as recited in claim 1 wherein said step of directly reconstructing
2 includes the step of computing a configuration parameter function.

1 3. The method as recited in claim 1 wherein said step of directly reconstructing
2 includes the step of computing a configuration kernel.

1 4. The method as recited in claim 1 wherein said step of directly reconstructing
2 includes the step of computing a configuration parameter response function for each of the
3 configuration parameters.

1 5. A method for estimating a loop composition in terms of loop parameters
2 representative of the loop composition comprising the steps of
3 energizing the loop from a measurement end with an energy source,
4 measuring a response signal from the loop at the measurement end,
5 wherein each of the loop parameters is related to response signal by a linear operator, and

1 directly reconstructing each of the loop parameters by executing a
2 prescribed mathematical algorithm, determined with reference to the linear operator, on
3 the response signal.

1 6. The method as recited in claim 5 wherein said step of directly reconstructing
2 includes the step of computing a loop parameter function.

Sub A1
1 7. The method as recited in claim 5 wherein said step of directly reconstructing
2 includes the step of computing a loop kernel.

1 8. The method as recited in claim 5 wherein said step of directly reconstructing
2 includes the step of computing a parameter response function for each of the loop
3 parameters.

1 9. A method for estimating a loop composition of a subscriber loop in terms of
2 loop parameters $X_1, X_2, \dots, X_i, \dots, X_N$, the loop having a frequency-domain response
3 $H(\omega, X_1, X_2, \dots, X_i, \dots, X_N)$ for the loop parameters, the method comprising the steps of

4 (a) determining a range for each loop parameter X_i ,
5 (b) for each loop parameter X_i , generating a frequency-domain loop
6 parameter function $F_{X_i}(\omega)$ wherein

7
$$F_{X_i}(\omega) = \int_{X_1} \int_{X_2} \dots \int_{X_i} \dots \int_{X_N} X_i H(\omega, X_1, X_2, \dots, X_i, \dots, X_N) dX_1 dX_2 \dots dX_i \dots dX_N,$$

8 (c) generating a loop kernel $k(\omega, \beta)$ for all loop parameters wherein

1 $k(\omega, \beta) = \int_{X_1 X_2} \dots \int_{X_N} H(\omega, X_1, X_2, \dots, X_N) H(\beta, X_1, X_2, \dots, X_N) dX_1 dX_2 \dots dX_N,$

2 (d) generating a parameter response function $g_i(\beta)$ for each loop

3 parameter from the integral relation $F_{X_i}(\omega) = \int_{\beta} k(\omega, \beta) g_i(\beta) d\beta,$

4 (e) energizing the loop from a measurement end with an energy source,

5 (f) measuring a response signal $H_R(\omega) = H(\omega, X_1, X_2, \dots, X_i, \dots, X_N)$

6 for the loop at the measurement end, and

7 (g) directly determining each loop parameter X_i from the integral relation

8 $X_i = \int_{\beta} H_R(\beta) g_i(\beta) d\beta.$

1 10. The method as recited in claim 9 wherein step (e) includes the step of
2 computing the inverse of $k(\omega, \beta)$.

1 11. The method as recited in claim 9 wherein step (e) includes the step of
2 computing the inverse of $k(\omega, \beta)$ using singular value decomposition.

1 12. The method as recited in claim 11 wherein step (f) includes the step of filtering
2 noise from the response signal.

1 13. A system for generating the loop composition in terms of loop parameters
2 representative of the loop composition comprising
3 a source of waves for energizing the loop from a measurement end,

1 a detector for detecting a response signal from the loop at the measurement
2 end, wherein each of the loop parameters is related to response signal by an integral
3 operator, and
4 a reconstructor for directly reconstructing each of the loop parameters by
5 executing a prescribed mathematical algorithm, determined with reference to the integral
6 operator, on the response signal.

Sul A1
1 14. The system as recited in claim 13 wherein said reconstructor includes a
2 processor for computing a loop parameter function.

1 15. The system as recited in claim 13 wherein said reconstructor includes a
2 processor for computing a loop kernel.

1 16. The system as recited in claim 13 wherein said reconstructor includes a
2 processor for computing a parameter response function for each of the loop parameters.